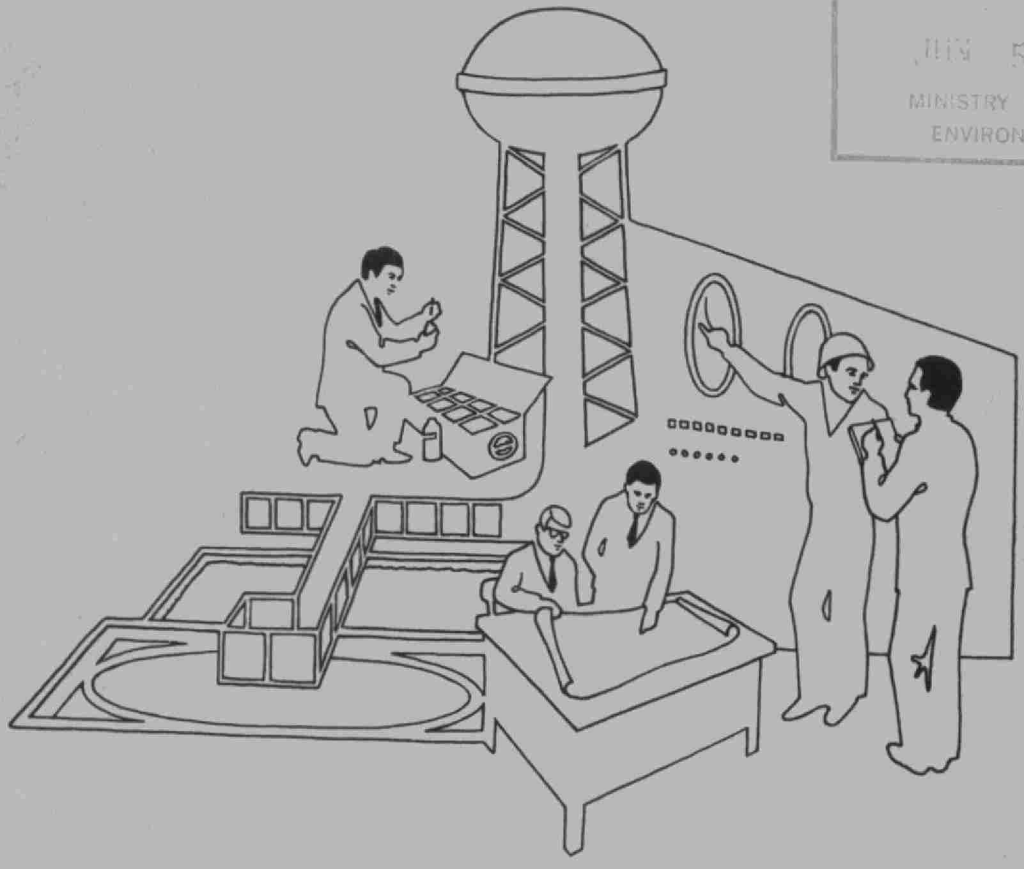
Water management in Ontario

Ontario Water Resources Commission

District Engineers Branch



CNR NEEBING YARDS POLLUTION SURVEY

City of Thunder Bay

June 16, 1971

R. T. Rinne, Student

DISTRICT ENGINEERS BRANCH - FIELD INVESTIGATIONS

MUNICIPALITY - City of Thunder Bay

DATE - June 16, 1971

MATTER INVESTIGATED - CNR NEEBING YARDS - Pollution Survey

REPORT BY - R. T. Rinne
Student Engineer

AT REQUEST OF - J. R. Marsh
District Engineer

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CNR
Winnipeg, Manitoba (Att: Mr. H.M. Hamilton, P.Eng.
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NO	DATE PREPARED	DATE TYPED	TYPED BY	DATE APPROVED	DATE MAILED
	Sept. , 1971	Sept. 24, 1971	:sn	Oct. 15 , 1971	Oct. 18 ,1971

REPORT

Ontario Water Resources Commission

Municipality City of Thunder Bay Date of Inspection June 16, 1971

Re: CNR NEEBING OUTFALL SURVEY

Field Inspection by R. T. Rinne, Engineering Student Report by R. T. Rinne

INTRODUCTION

On June 16, 1971, district staff conducted a pollution survey of the drainage basin in the vicinity of the CNR Neebing Yard and the outfall area to the Kaministikwia River. The survey consisted of 8-hour composite sampling at the strategic locations shown in Diagram 1, together with observations of the entire study area

PURPOSE OF INVESTIGATION

Throughout 1970 to the present, numerous pollution complaints regarding oil in the discharge ditch were reported to the Regional Office. The discharge was periodically sampled to monitor the quality of the effluent. The data obtained from this sampling along with visual observations, indicated that sanitary wastes were being discharged to the ditch.

It was learned through discussion with local CNR officials that the CNR is preparing plans to relocate many of the downtown facilities to the Neebing Yard. Since municipal waste disposal services cannot be made "available until after 1975 at the earliest"* an interim waste disposal facility would be required until that time.

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* Memo J.R.Marsh to J.R.Barr, Dec. 28, 1970, re meeting with CNR officials regarding CNR Neebing Yards.

SCOPE OF THE REPORT

Primarily, the investigation was to determine the source(s) of the wastes gaining access to the drain and the effect that these wastes were having on the receiving watercourse.

Sampling locations within the collector system for the outfall were selected so that a definite pattern for the contaminants could be traced. Previous samples collected from the discharge and a preliminary site investigation conducted on May 8, 1971, were used as the basis for establishment of the parameters used in this report.

In order to evaluate the effect of this discharge to the receiving watercourse, sampling locations were established in the drainage ditch as well as the Kaminstikwia River. Also, flow data was obtained to determine approximately the volume of discharge to the Kaministikwia River.

METHOD OF SAMPLING

The sampling procedure that was to be used was first discussed in detail with the District Engineer and the Scientist-in-Charge at the Thunder Bay Regional Office in order to utilize the appropriate method for the required purpose and scope of this investigation.

It was decided to utilize an 8-hr. composite chemical sampling period - 8:00 a.m. to 4:00 p.m. with aliquots being collected every two hours. Three bacteriological samples were to be taken at 8 a.m., 12 noon and 4 p.m. to provide a "composite type" sample by means of calculating the geometric mean of the three results obtained. Also a composite chemical sample was collected from the outfall and the discharge location into the Kaministikwia River and sent to the Toronto Laboratory for petroleum analyses.

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Sampling locations were chosen (as shown in site plan, Appendix V) to isolate the various contributions into the system. Also, the effect of this discharge on the Kaministikwia River was determined by means of upstream and downstream sampling locations. An attempt was made to establish approximate plume boundaries in the Kaministikwia River (refer Appendix III). Since the effect of this discharge on the Kaministikwia River was to be established relatively accurately, depth samples were taken in the Kaministikwia River when the river depth would permit.

It was felt that these procedures would best satisfy the intentions of the investigation.

SITE DESCRIPTION AND OBSERVATIONS

The CNR Neebing Yard serves as the base for 45-65 men on a shift basis. Water is supplied by means of an 18-inch main from a connection to the City supply at Montreal Street and Neebing Avenue. The rate of consumption ranges between 80-140 gpm*. The wastes originating from the site are collected in a sewer system and discharged into a ditch south of Glendale Crescent which then carries the wastes to the Kaministikwia River. A portion of the domestic wastes is disposed of using septic tanks and tile fields as shown on the site plan, while the remainder of the domestic wastes discharges into the sewer system. The waste discharge, as measured in the ditch with the use of an OTT current meter, was found to be approximately 130 gpm.

The effluent in manhole #1 was relatively clear and a small amount of toilet tissue was visible at the bottom. Manhole #1 contained

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* CNR Engineering Department, Thunder Bay

a murky effluent and the bottom of the manhole was not visible. A distinct oily film coated the surface of the liquid in Manhole #1. Upon investigation of the manhole just north of Manhole #1, large amounts of toilet tissue were visible in the murky liquid.

At the outfall sampling location #4, a 3'x3'x1.5' steel settling box is used in an attempt to prevent the solids from gaining access to the ditch. Just downstream of the outfall, bales of straw have been placed across the stream to absorb any oil in the discharge. Most of the flow was proceeding around the bales, resulting in the bales being ineffective. The upper portions of the ditch (200 ft.) had banks which were black from the oil they had absorbed. A distinct oily smell was predominant in this immediate area. Near the Kaministikwia River, the banks of the ditch displayed no noticeable traces of oil. The only visible oil was an oil plume which developed in the Kaministikwia River subsequent to the discharge into it.

ANALYSES RESULTS

Sampling location #3 is indicative of the waste output from the CNR Neebing Yard.

A high concentration of iron was present with a value of 9.5 mg/l. In the stream between locations #4 and #6 (see Appendix V). Some of this suspended iron had settled out as sediments in the ditch. With a high iron concentration, the conductivity was high as could be expected. The analyses for petroleum products at location #3 revealed their presence, although a qualitative,or quantitative,analyses was not possible (refer Appendix II, Report (A)).

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The discharge from the yards tends to be rather cloudy and this is illustrated by the turbidity value of 64 units. The high total coliform and fecal coliform counts of 1.665×10^6 and 6.169×10^4 per 100 ml, respectively, in conjunction with the high chemical parameters concentrations indicate that sanitary wastes appear to be a rather dominant portion of the discharge with regard to bacteriological and chemical characteristics. This sanitary waste would also account for the cloudiness of the discharge. "Fresh domestic sewage has a slightly soapy or oil odour and in appearance is cloudy, with a colour similar to that of a soap solution".*

For tracing these various output concentrations back into the CNR yards, we can look at Manholes #1 and #2. The analyses results from Manhole #1 (Appendix I) clearly indicate a discharge capable of causing pollution in the downstream watercourse.

The extreme BOD_5 of 205 mg/l in Manhole #1 (although not optimum value, Laboratory indicated that BOD_5 was greater than 100 mg/l) indicates that there is a high demand on the available oxygen. The total coliform and fecal coliform counts in Manhole #1 contents were 3.846×10^7 and 1.411×10^6 per 100 ml respectively. The extreme bacteria counts along with the high BOD_5, high nutrient and chloride concentrations indicate a sanitary waste discharge of high concentration.

From the bacteriological results for Manhole #2, contents, it

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* Water Supply & Sewerage, E.W. Steel, McGraw-Hill, 1960, pg. 444

appears that some domestic waste is originating from this end of the yard, although it is not of extreme concentration and/or volume. In general, the various parameters considered are much more moderate with regard to concentration in Manhole #2 than Manhole #1. In fact, the discharge from Manhole #2 tends to dilute the much higher concentrated discharge from Manhole #1.

At sampling location #3A, the drainage from the west side of the yards discharges to a manhole as shown in the site plan. For simply a surface drainage discharge, the nutrients, chlorides and bacteriological concentrations appears to be too great. It appears as if some domestic waste may possibly be entering the pipe between Broadway Avenue and Manhole #3A.

Once the discharge enters the open ditch via the outfall, the quality of the discharge could be expected to improve with regard to the various parameters considered. This is due to the fact that the terrain allows for aeration, settlement of solids and depletion of the bacteriological concentrations.

At sampling location #5, approximately midpoint between the discharge pipe and the end of the ditch at sampling location #6, a slight improvement in the chemical characteristics of the discharge were noted. For some reason, the total coliform and fecal coliform counts increased from 8.414×10^5 to 1.593×10^6 per 100 ml. and from 2.362×10^4 to 1.153×10^5 per 100 ml. respectively. The bacterial increase would indicate an additional source of bacterial contamination somewhere in the upper portions of the stream. Upon further investigation, additional

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source of pollution proved to be several homes on Glendale Crescent which discharge domestic wastes from their septic tanks into the stream.

Sampling location #6, at the confluence of the ditch and the Kam River displayed a general improvement in the water quality of the discharge from the outfall pipe. Both chemical and bacteriological parameters exhibited this improvement with regard to water quality. The analysis for petroleum products at location #6 revealed their presence but qualitative and quantative analysis was not possible.

What is flowing into the Kam River is a discharge with the chemical and bacteriological characteristics at sampling location #6 (refer Appendix I).

Observing the chemical analyses for locations #7 and #10, it can be said that location #10 appears to be on the very outer fringes of the plume since locations #7 and #10 exhibit similar chemical characteristics. The bacteriological analyses indicates a slight plume influence at sampling location #10.

Assuming that location #10 is at the very outer edge of the plume and upon consideration of the chemical analyses in Appendix I, it appears that location #9 is in the vicinity of the centre of the plume. Bacteriologically, the center of the plume can be assumed to be somewhere between locations #8 and #9. Upon closer observation of the relative concentrations of the various parameters, the centre of the plume would be somewhere between locations #8 and #9 with location #10 at the outer fringe of the plume.

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Below the surface, the plume appears to have an extended area of effect, possibly due to the current in the Kam River. As discussed previously, the parameter concentrations at location #10 were only slightly higher than those at location #7, the upstream location on the Kam River. Below the surface, location #10D exhibits considerably poorer water quality than location #7D.

In comparing location #9 with locations #11 and 11D, which are 100 feet directly downstream, there was an improvement in the water quality in the downstream direction. There appeared to be a definite trend developing in the plume. The solids decreased in concentration in the downstream direction but as in location #11 and #11D, the solids were greater below the surface than at the surface. The solids therefore appear to be settling out as they proceed downstream. (Refer Appendix IV, Graph (c)).

Location #11 is definitely still under the influence of the discharge plume from the ditch. In examining the data for locations #11 and #12, in comparison to the control location #7, the plume effect is only slightly noticeable at the surface. Below the surface at locations #11D and #12D in comparison to the control location #7D, the plume effect is much more predominant than at the surface. The plume has little effect at location #12D which is about one-quarter mile down the Kam River. At this location, there are only minor increases in a few of the parameters in comparison to the upstream location at #7D.

SUMMARY AND CONCLUSIONS

The study of the CNR Neebing Yards has revealed that both domestic and operational wastes of considerable concentrations are discharged into the Kaministikwia via the outfall ditch.

Concentrations of iron and petroleum products were notable constituents of the discharge. Both the site observations and the chemical analyses previously presented substantiate these conclusions.

The iron was found to settle out as the flow proceeded along in the outfall ditch. Further settling was observed at the confluence of the outfall ditch and the Kaministikwia River. The petroleum products were being absorbed by the banks of the ditch, especially in the upper reaches. An oily plume was visible for a short distance in the Kaministikwia River downstream from the confluence region. These constituents impair the water quality in the Kaministikwia adjacent to the confluence region a short way downstream.

Approximately one-quarter mile downstream on the Kaministikwia River, the water quality appeared to have reverted back to that of the upstream monitoring location. Other than the iron settling out onto the bottom, the Kaministikwia River appears to be able to assimilate this waste discharge, within the one-quarter mile.

At the time of writing, the CNR was installing facilities to prevent any petroleum products from gaining access to the outfall ditch and consequently the Kaministikwia River. The Division of Industrial Wastes is presently negotiating with the CNR for the treatment of all the operational wastes from the site.

The suspected discharge of domestic wastes into the Kaministikwia River was confirmed by this investigation.

The chemical and bacteriological analyses indicate that domestic wastes represent a dominant portion of the overall discharge from the CNR Neebing Yards. Since all the discharge is collected into one main sewer,

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it seems rather irrelevant to consider the various individual sources in detail, due to the fact that overall treatment should be contemplated. Sample location 3 is characteristic of the overall discharge from the CNR yards. The bacteriological and chemical characteristics of the surface drainage from the west side of the CNR yards indicate a possible domestic waste contribution. The source of this domestic waste may be homes in the vicinity which possibly are discharging either into the ditch leading to the pipe or directly into the pipe south of Broadway Avenue. This possibility should be referred to the Thunder Bay Health Unit for investigation.

The discharge tends to improve with regard to water quality as it proceeds down into the Kaministikwia River. The only exception was at sample location 5 where there was a notable decrease in water quality (refer to Appendix IV, Graph (a)). Upon investigation, it was discovered that several homes on Glendale Crescent had septic tanks which discharged directly into the ditch. This discharge, as well as the bacteriological state of the ditch, are a public health hazard, especially to the children playing in these areas.

At the plume sampling locations, (refer to Appendix III), the bacteria concentration was noticeably higher, adjacent to the shoreline. The quiescent condition present at this location could result in a slightly increased bacterial count in comparison to the values at the confluence region.

As shown in Appendix IV, Graph (C), the solids appear to be settling out as the discharge proceeds down the Kaministikwia River. The

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Kaministikwia River appears to be able to assimilate the effluent with the exception of the solids which would appear as sediments in the river bottom. This contribution to the Kaministikwia could be considered as impairment to the river.

Impairment of the Kaministikwia River does occur up to sampling location #11 as shown in Appendix IV Graph (b). Since impairment of the receiving watercourse is occurring, steps should be taken to effect satisfactory treatment for this discharge.

Roy T. Rinne
Engineering Student
Division of Sanitary Engineering

RTR:sn

Bacteriological and Chemical Data

APPENDIX 1

TABLE 1

Analysis \ Sample Location	#1	#2	#3	#3A	#4	#5	#6	#7	#7D	#8	#9	#10	#10D	#11	#11D	#12	#12D
BOD_5	205*	2.4*	5.0*	9.2*	7.2*	15*	10	1.2	1.4	5.4	11	1.6	2.2	1.5	1.4	1.5	1.6
Total Solids	650	90	350	250	280	235	220	90	80	170	220	95	140	80	120	80	285
Turbidity Units	52	3.3	64	14	23	23	20	3.7	4.0	12	22	5	6.7	4.8	5.3	4.2	4.2
NITROGEN																	
Free NH_3	3.1	.58	.56	.66	.78	.60	.46	.00	.00	.19	.43	.00	.00	.00	.00	.00	.00
Tot.Kjel.	7.8	2.3	.50	1.8	2.0	1.8	1.9	.60	.62	.44	.45	.67	.74	.58	.58	.64	.65
Nitrite	.011	.074	.015	.052	.049	.043	.039	.008	.007	.022	.039	.008	.007	.007	.007	.007	.007
Nitrate	.01	.12	.03	.14	.14	.14	.12	.01	.02	.05	.10	.14	.14	.14	.01	.01	.01
PHOSPHORUS																	
Total	1.9	.24	.24	.28	.50	.22	.24	.022	.022	.17	.45	.023	.074	.024	.049	.035	.019
Soluble	.11	.060	.027	.080	.080	.054	.048	.004	.004	.044	.098	.006	.005	.004	.003	.012	.002
Chloride as Cl	210	4	30	68	62	39	17	0	0	7	16	0	0	0	0	0	0
pH	7.0	6.9	7.1	6.9	6.9	7.0	7.2	7.4	7.4	7.2	7.2	7.5	7.5	7.4	7.4	7.4	7.4
Conductivity	1025	131	440	405	424	349	276	70	70	165	268	73	72	70	74	72	70
** Total Coliform Bact.	3.846×10^7	1.986×10^5	1.665×10^6	8.804×10^5	8.414×10^5	1.593×10^6	785600	931	502	7.949×10^5	7.59×10^5	3380	5337	2494	2044	885	584
**Faecal Coliform	1.411×10^6	3710	6.169×10^4	2.603×10^4	2.367×10^4	1.153×10^5	23590	19	14	2.334×10^5	3.432×10^4	74	233	53	216	10	5
Iron as Fe	11	.80	9.5	3.4	5.0	4.6	3.5	.50	.50	2.5	3.5	.75	.70	.65	1.5	.50	.50

Note:
D - depth sample - 0.5 of depth
* not optimum values
** geometric mean of three samples

ONTARIO WATER RESOURCES COMMISSION
CHEMICAL LABORATORIES

APPENDIX 11
Report (a)

All analyses except pH reported in p.p.m. unless otherwise indicated

ORGANIC ANALYSIS

1 p.p.m. = 1 mgm. / litre = 1 lb. / 100,000 Imp. Gals.

Municipality: City of Thunder Bay

Source: C.N.R. Neebing Outfall Survey

Date Sampled: June 16/71 by: R.T.R.

Report to: J. R. Marsh, District Engineer
Thunder Bay Regional Office
Att: R. T. Rinne
P. Diosady
G. Rees

c.c. Central Files

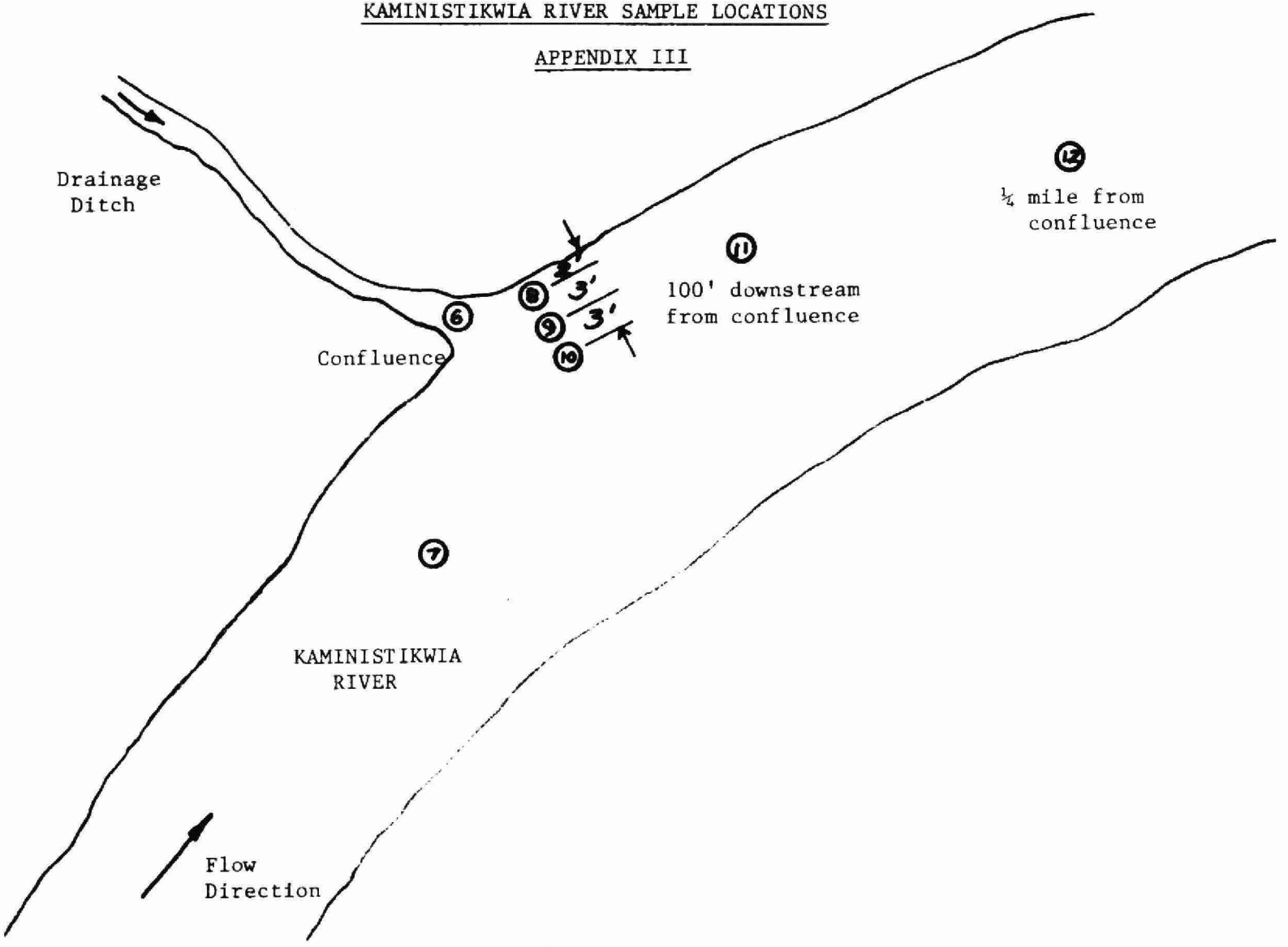
Lab. No.	Petroleum Products
0-1362	*
0-1363	*
	* Samples were analysed by gas chromatography for petroleum products. Although some petroleum products were detected a qualitative identification was not possible. The samples contained insufficient material for I.R. spectrum analysis.

0-1362	#3	Station #3 manhole C.N.R. yard South.
0-1363	#6	Station #6 confluence of stream and Kam River.

5M-60-31784

KAMINISTIKWIA RIVER SAMPLE LOCATIONS

APPENDIX III

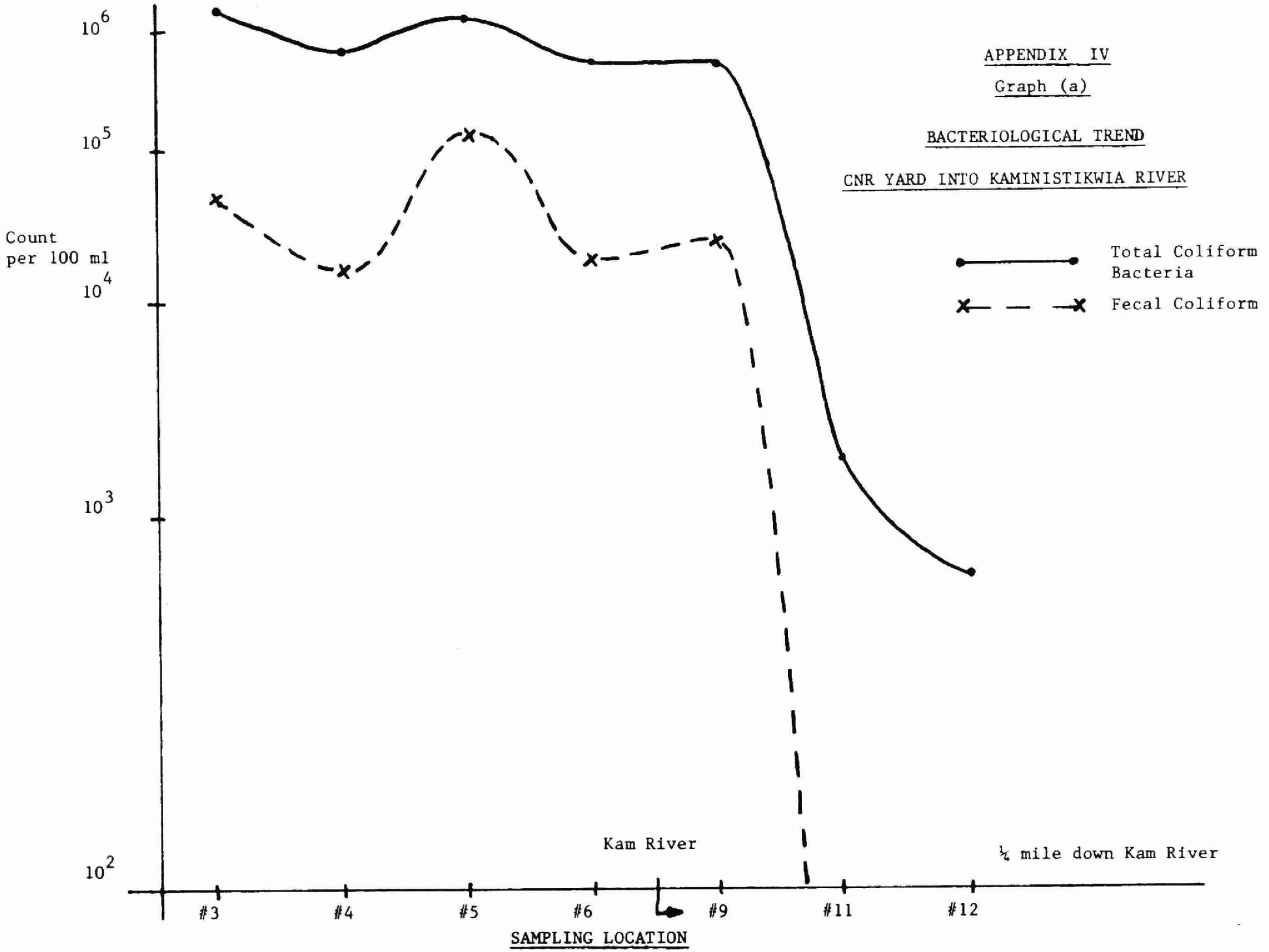


APPENDIX IV

Graph (a)

BACTERIOLOGICAL TREND

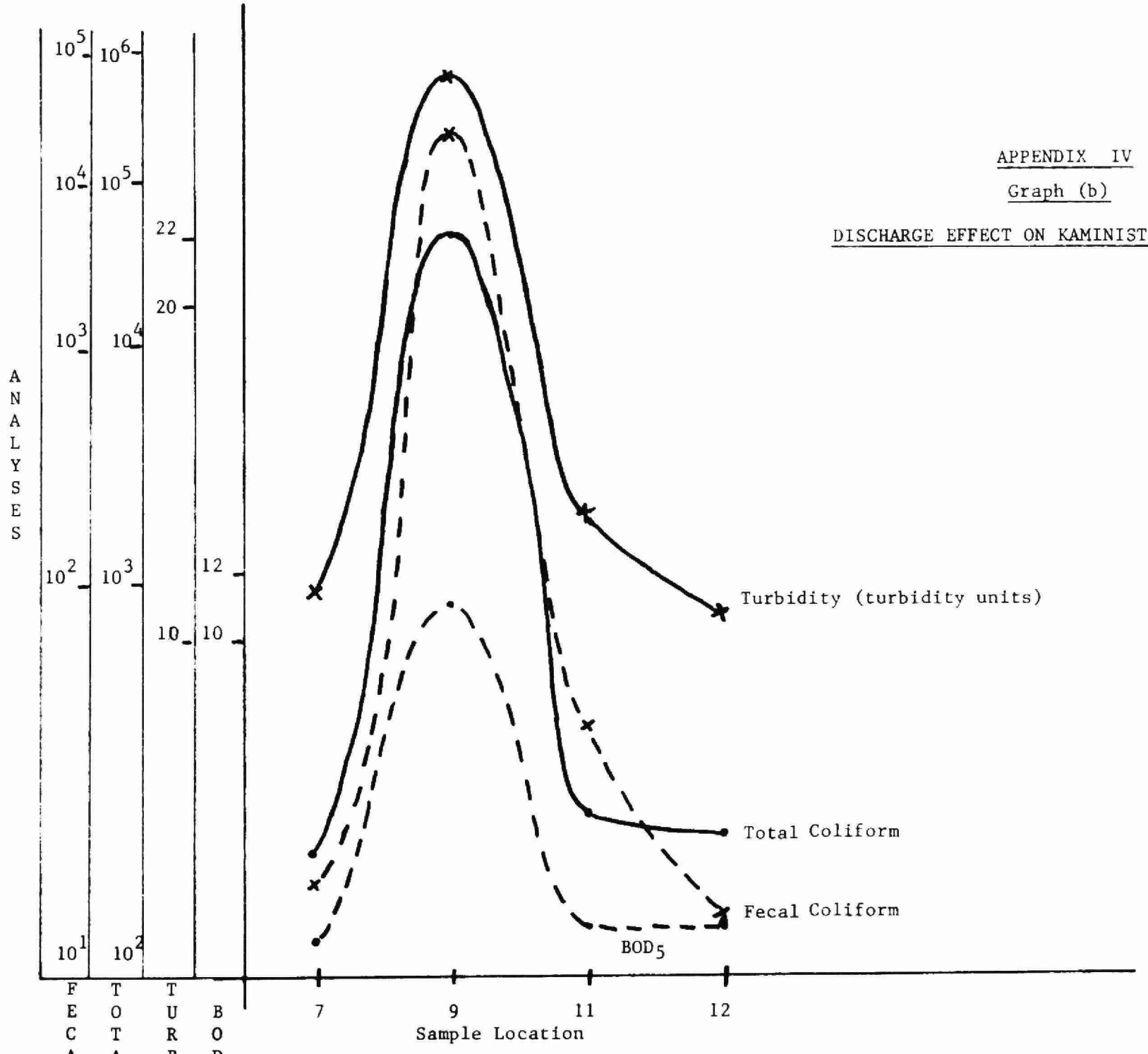
CNR YARD INTO KAMINISTIKWIA RIVER

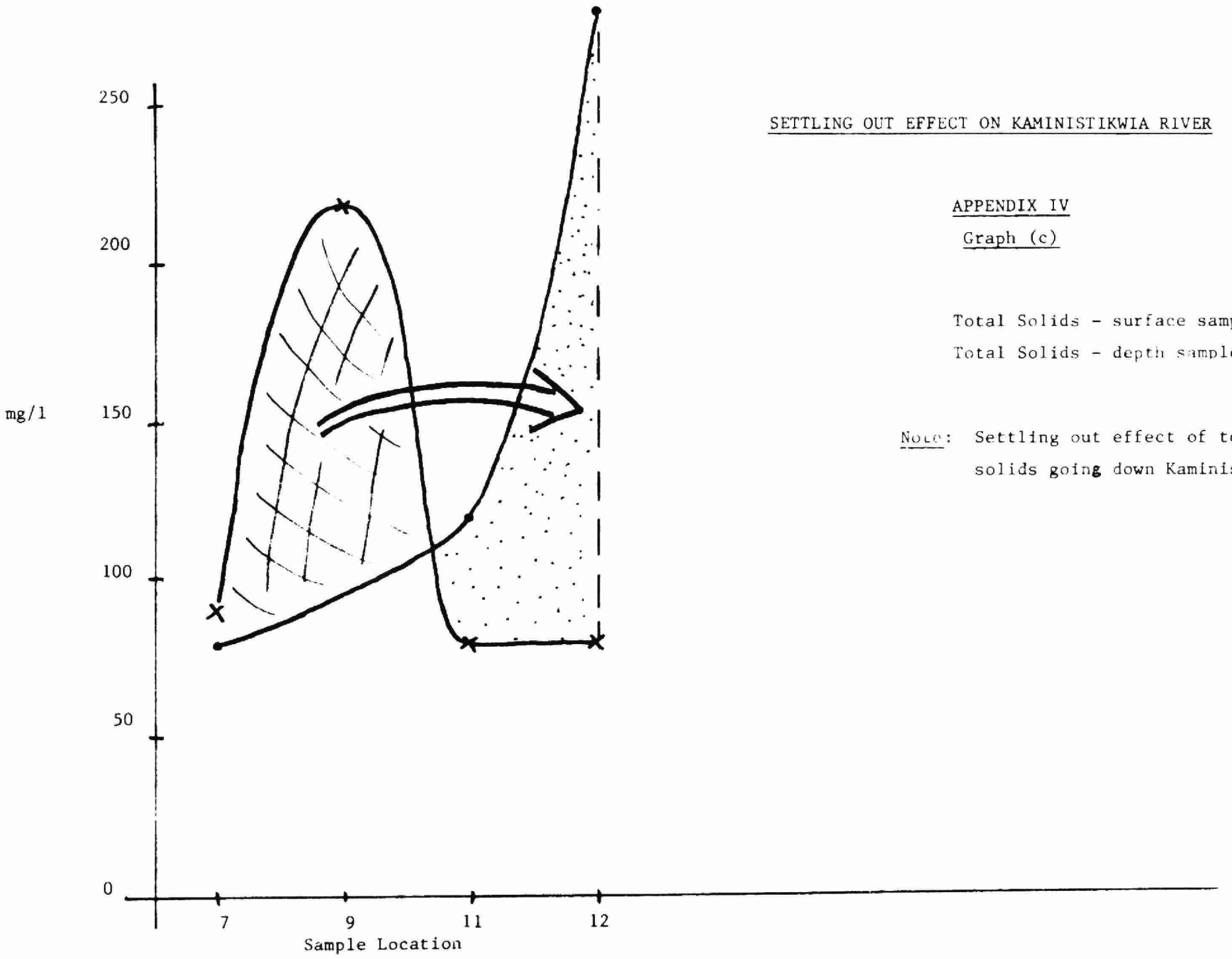


APPENDIX IV

Graph (b)

DISCHARGE EFFECT ON KAMINISTIKWIA RIVER





SETTLING OUT EFFECT ON KAMINISTIKWIA RIVER

APPENDIX IV

Graph (c)

Total Solids - surface sample

Total Solids - depth sample

Note: Settling out effect of total solids going down Kaministikwia R.

CANADIAN NATIONAL RAILWAY
NEEBING YARD

TILE FIELD

TILE FIELD

BROADWAY AVENUE

GLENDALE CRES.

GRUENS RD.

KAMINISTIKWIA RIVER

SETTLING BOX

LEGEND

- SEPTIC TANK
- MANHOLE
- CATCH BASIN
- WASTE DISCHARGE PIPES - BURIED
- DRAINAGE DITCH
- SAMPLING LOCATION

N

ONTARIO WATER RESOURCES COMMISSION

C.N.R. NEEBING - OUTFALL VICINITY

DWN. BY: R.T.R.	DATE: JUNE 1971	SCALE: 1" ≈ 250'